

## COMATILIA, A REMARKABLE NEW GENUS OF UN-STALKED CRINOIDS.

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The elaborate definition of the genus *Actinometra* (the family Comasteridæ as now understood) given by Dr. P. H. Carpenter in the Challenger Reports, and the various additional characters noted by him in different places in the same work, would seem to have established its status definitely, and to have demonstrated conclusively that it formed a well-circumscribed unit, very sharply contrasted with the aggregation of species called by Doctor Carpenter *Antedon*; in other words, that the recent free crinoids without basals and with ten or more arms fall naturally into two well-defined structural types, separated from each other by more numerous and more important characters than exist between the various specific groups within the two types. At the beginning of my studies I had become convinced from the available material that the division of these forms into two sharply contrasted groups was very artificial, and could not stand the test of modern systematic methods, in the light of our greatly increased knowledge. I therefore proposed to recognize, instead of the two genera "*Antedon*" and "*Actinometra*" used by Carpenter, five great divisions (the families Comasteridæ, Zygometridæ, Himerometridæ, Tropiometridæ, and Thalassometridæ) which covered exactly the same ground, except that the number of included species was nearly, if not quite, doubled. Each of these families appeared to me to be separated from the others by characters of just as great importance as the Comasteridæ (the old *Actinometra*) was from any one of them.

My suspicions in regard to many of the characters relied upon to differentiate "*Actinometra*" from "*Antedon*" have recently been confirmed in a most conclusive manner. In examining some comatulids taken by the U. S. Bureau of Fisheries steamer *Albatross* in deep water between the Bahama Islands and Cape Fear, North Carolina, I found a most peculiar form which, according to the structure of its oral pinnules and brachials, belongs to the Comasteridæ, but

which, judged upon its other characters, might be placed in the Antedonidæ, Himerometridæ, Thalassometridæ, or Tropiometridæ, while certain features find a parallel only in *Rhizocrinus* and *Bathycrinus*. Briefly stated, the essential features of the Comasteridæ are, an eccentric mouth, large central or subcentral anal tube, ambulacra quite without calcareous plating, absence of sacculi, stout cirri with short joints, and the full complement of pinnules, the lowest of which bear terminal combs. The first and the last are the characters upon which most reliance is usually placed. In this new form the mouth is always central, the anal tube small and marginal, sacculi are present (though rare), the cirri are exceedingly slender, with greatly elongated joints, the six pinnules following the first two ( $P_1$  and  $P_a$ ) are lacking, the pinnule ambulacra are provided with large side plates, and the two lowest pinnules are combed. In its central mouth this new species agrees with all the other recent species except those of the Comasteridæ, and the same is true in regard to the sacculi; the delicate cirri find counterparts only in the Antedonidæ, in the genera *Hathrometra* and *Iridometra*; the deficient pinnulation recalls *Perometra* and *Hypalometra* among the Antedonidæ, *Cyllometra* and *Colobometra* among the Himerometridæ (with this exception, that the first inner pinnule, on the fourth brachial,  $P_a$ , is always the first to disappear in these genera, while it is invariably present in the new form), and also *Atelecrinus* of the Atelecrinidæ; the development of an ambulacral plating is found perfected only in the Thalassometridæ and in the Tropiometridæ. Taken as a whole, the greatest resemblance in size and general build is to the little littoral Antedonids of the East Indies belonging to the genus *Iridometra*, *I. nana* in particular, and this in spite of the fact that it has the deepest habitat of any of the Comasteridæ.

The development of plating along the ambulacra in the family Comasteridæ was first demonstrated by Mr. Frank Springer, who showed its presence in a new species of *Comaster*, *C. iowensis*, from the Tortugas. I have since found it to be a constant feature of the West Indian species of this genus, even including *C. lineata*, in which I detected it in specimens previously examined by Carpenter.

No less interesting than the adults are the young, as shown by a single specimen with an arm length of probably about 7 mm. Had it not been found with the fully grown, it could very well have passed as a new species of *Thaumatocrinus*, or the representative of a genus intermediate between *Thaumatocrinus* and *Antedon*.

*Thaumatocrinus renovatus* was based upon a very peculiar comatulid which had been dredged by the *Challenger* in  $50^{\circ} 01'$  S. lat.,  $128^{\circ} 04'$  E. long., at a depth of 1,800 fathoms. Doctor Carpenter's diagnosis of the genus, as given in the *Challenger Reports*, is:

Calyx composed of a centro-dorsal, basals, radials, and primary interradials, the latter resting on the basals and so separating them

laterally; that on the anal side bears a short jointed appendage; mouth central and protected by five large oral plates which occupy the greater part of the disk, and are separated from the calyx interradials by two or three rows of small irregular plates; five arms only.

Doctor Carpenter discusses at considerable length the similarity between *Thaumatocrinus* and a number of palæozoic forms, and, although he includes it in the "Comatulidæ" as understood by him, he is inclined to regard it as a very anomalous type, exhibiting certain atavistic characters. The type-specimen of *Thaumatocrinus renovatus* is exceedingly small; the total width of the calyx across the disk is barely 2 mm., and the height of the centro-dorsal and radials together is about the same.

The arm structure of *Thaumatocrinus* is identical with that of *Pentametrocrinus* and *Decametrocrinus*, which together form the family Pentametrocrinidæ, and in its pinnule and cirrus structure, in so far as it can be made out, it also agrees with the conditions found in those genera. The arm and pinnule structure of the Pentametrocrinidæ is unique in its simplicity among the comatulids, which in itself suggests that it is a family of a remarkably primitive type. The adult *Pentametrocrinus* differs from the adult *Antedon* in its more generalized and presumably more primitive structure; if we take a young *Antedon* and generalize it by supplementing its single interrarial (anal) with four others like it, we would find a *Thaumatocrinus* as a result. *Thaumatocrinus* in every detail except such as, from analogy with *Antedon*, may be safely ascribed to immaturity, agrees with *Pentametrocrinus*; hence it seems probable, as the atavistic *Thaumatocrinus* bears a very similar relation to the young *Antedon* to that which the primitive *Pentametrocrinus* does to the adult *Antedon*, and as *Thaumatocrinus* and *Pentametrocrinus* agree in all essentials fully as well as the young and the adult of *Antedon* agree, that *Thaumatocrinus* is in reality nothing more nor less than the young of *Pentametrocrinus*. But there is still further evidence. In *Decametrocrinus*, which is a meristic variation from *Pentametrocrinus*, differing only in having twice as many radials and arms, the ends of the five basal rays appear externally in the angles of the calyx, dividing the ten radials into groups of two; but in *Promachocrinus*, which is a similar meristic variation from *Heliometra* or a closely allied genus, the ends of the basal rays appear externally under the center of alternate radials. *Promachocrinus* probably has young much like those of the closely allied *Heliometra*, in which there is but a single interrarial plate, the anal; now the division of each radial in the young of *Promachocrinus*, and the growth of each resultant half to the same size as the single undivided radial in *Heliometra*, would, as the anal plate is lifted out from between the posterior radials, produce a certain amount of torsion of the

calyx, and might very well result in causing the basals in the adult to occupy a position under alternate radials. The appearance of the basal rays in *Decametrocrinus* between the radials instead of under alternate ones is a difference of considerable morphological importance, suggesting that the young are of quite different structure. *Decametrocrinus* is a meristic variation from *Pentametrocrinus*; *Thaumatocrinus*, probably the young of *Pentametrocrinus*, has interradial plates of equal size in all the interradial areas; now if the young of *Decametrocrinus* were of the *Thaumatocrinus* type with five equal interradials which, during growth, were shoved out from between the radials at an equal rate, the basal rays in the adult would maintain exactly the same relation to the radials as the basals did to the radials in the young, instead of being twisted about into a semiradial position as in *Promachocrinus*. Thus a comparison of adults of the ten-rayed genera of the Pentametrocrinidæ and Antedonidæ leads to the same conclusions as a comparison of *Thaumatocrinus* with the *Antedon* larva, namely, that *Thaumatocrinus* is the young of *Pentametrocrinus*.

By this reasoning I had sometime ago reached the conclusion that *Thaumatocrinus* was very close to *Pentametrocrinus*, and probably the young of it, and I therefore placed it next to *Pentametrocrinus* in the family Pentametrocrinidæ. Here the matter rested, for nothing further could be done without additional facts to prove or disprove the results attained by purely speculative processes.

The young example of this new comatulid is so like *Thaumatocrinus* in certain ways as to convince me that I was right in my tentative treatment of that genus. It represents, however, a more advanced stage; the five large, strong orals are present as in *T. renovatus*, surrounded by small irregular plates; the basals are not evident externally; the radials are in lateral contact, and just above their apposed lateral edges in the angles of the calyx are five large interradials which appear to have been recently thrust forward from between them, but which are not yet undergoing the process of resorption. In the large and persistent orals and interradials (though displaced) this young specimen resembles *Thaumatocrinus*, though it is true that it differs from it in the approximation of the radials and in the absence of external basals; but there can, I think, be no reasonable doubt that these differences are merely the result of its greater development. The arm structure, so far as it is elaborated, resembles that of the adult.

This new form is undoubtedly referable to the Comasteridæ, as evidenced by the characteristic pinnules with short joints, coarsely spinous on their distal ends, finely spinous dorsally, the comb on the terminal portion of the first pair, the coarsely spinous overlap of the brachials, and their spinous dorsal surface. This appears to out-

weigh all the other features. The ambulacral plating is unlike that developed in the Antedonidæ, Tropiometridæ, or Thalassometridæ, in that there is only a single series of plates instead of both side and covering plates; these appear to represent the side plates of other forms, and not the covering plates, as does the single series in *Rhizocrinus*. The development of covering plates is an uncertain quantity, and one upon which too much stress has previously been laid. Hartlaub and Minckert both divided the old genus "*Antedon*" into two sections, one with and one without them; but both included in the "plated" section Carpenter's "Basicurva group," which contains species in which they are not found. Moreover, in the Tropiometridæ they are extraordinarily developed in *Calometra*, more or less imperfectly developed in *Asterometra* and *Ptilometra*, and quite undeveloped in *Tropiometra*; but more curious still, while they make their appearance in the pentacrinoid stage of the species of Thalassometridæ, they are not found in the young of *Ptilometra*. It is evident, therefore, that, though a valuable index to the systematic position of the comatulid species, they must be treated with great caution, as they appear to be very liable to sudden development, as is the case in *Heliometra*, in very unexpected places, and to equally disconcerting suppression. The central position of the mouth, while interesting, is of no real importance; it is usually nearly, and often quite, central, in *Phanogenia*, *Comatella*, and *Comaster*, and often more or less eccentric in *Heliometra* and in certain of the Himero-metridæ. Sacculi are somewhat uncertain organs at best, while cirri are so very variable that the occurrence of a new type need cause no trouble; the resemblance to the cirri of *Iridometra* is not borne out by the finer structure; for instance, in *Iridometra*, as in all comatulids heretofore known, the opposing spine is single, whereas in this new form it is forked.

I propose to recognize this new comatulid as follows:

#### Genus COMATILIA, new.

Centro-dorsal discoidal, moderate in size; cirrus sockets marginal, usually in a single row.

Cirri about XX, 9-10, about one-fifth of the arm length, very slender, the second and following joints much longer than broad, the third and fourth the longest, about four times as long as their proximal diameter; cirrus joints all with expanded ends; no dorsal spines; opposing spine forked in its distal half, or ending in a bunch of fine spines.

Arms 10; first four brachials oblong, broader than long, then obliquely wedge-shaped, at first as long as broad, soon becoming longer than broad and very long terminally; large interprimibrachs present, rounded, not contiguous.

Disk naked; mouth central, very large; anal tube small, marginal.

PP<sub>2, 3, 4, b, c, d</sub> absent; PP<sub>1</sub> and <sub>2</sub> long and slender, with a large terminal comb; pinnules from PP<sub>5, c</sub> gradually increasing in length, distally reaching approximately the length of the oral pinnules; the first three to six after PP<sub>5, c</sub> bear globular genital glands at the base; side plates developed on the outer three-fourths of the pinnule ambulacra, best developed in the distal half.

*Genotype.*—*Comatilia iridometriformis*.

COMATILIA IRIDOMETRIFORMIS, new species.

Centro-dorsal moderate, discoidal, the bare polar area flat, usually with a more or less developed low rounded median tubercle, 1 mm. to 1.5 mm. in diameter; cirrus sockets usually in a single, but often in a more or less partially double or triple marginal row.

Cirri XVI–XXVIII, 9–10, 5 mm. to 6 mm. long, exceedingly slender and delicate; first joint short, about twice as broad as long; second about twice as long as broad; third and fourth the longest, about four times as long as broad; fifth slightly shorter; following joints gradually decreasing in length, the antepenultimate being about half again as long as its distal diameter; penultimate joint about as long as, or slightly longer than, broad; second and following joints strongly “dice-box shaped” with expanded ends; after the fourth the proximal ends becoming less, the distal more expanded, so that the cirri as a whole bear a close resemblance to those of certain of the Antedonidæ, as *Hathrometra* and *Iridometra*; distal ends of the cirrus joints overlapping all around, but slightly more dorsally than ventrally, the dorsal overlap, however, exhibiting no tendency to project anteriorly: opposing spine terminal in position, directed obliquely forward, arising from the entire distal half (or rather more) of the dorsal side of the penultimate joint, about equal to one-half of the distal diameter of the joint in length, usually forking transversely in its distal half, more rarely breaking up into a number of small spines; terminal claw approximately equal in length to the penultimate joint, moderately stout, and evenly curved.

Ends of the basal rays visible as rather prominent tubercles in the interradial angles of the calyx; radials very short in the median line, but extending up in the angles of the calyx, separating the bases of the IBr<sub>1</sub> for a distance about equal to one-half of the basal diameter of those joints, the condition in general resembling that found in *Calometra multicolor* and in *Bathymetra*; two to four large oval or round interprimibrachs are found in each interradial area, which, however, are usually not quite contiguous; IBr<sub>1</sub> comparatively small, oblong, very short, between three and four times as broad as long; IBr<sub>2</sub> (axillary) broadly pentagonal, about twice as broad as long, the lateral edges about as long as those of the IBr<sub>1</sub>, making with them an obtuse angle.

Arms 10, about 30 mm. long; first brachial very short, oblong, about four times as broad as long, united basally with its fellow, diverging at approximately a right angle distally; second brachial usually about twice as large, wedge-shaped; third and fourth brachials (syzygial pair) somewhat longer than broad; following brachials very obliquely wedge-shaped, at first about as long as broad, but almost immediately becoming longer than broad and gradually increasing in length, being terminally two or three times as long as broad, or even longer, with expanded ends; after about the sixth the brachials develop strongly produced and overlapping distal ends, which are armed with a row of comparatively coarse spines. Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth, and distally at intervals of two oblique muscular articulations ("in alternate joints").

Mouth central and very large; anal tube small and marginal; disk naked, except for the previously mentioned interprimibrachial plates.

No pinnules on the fifth to the tenth brachials,  $PP_{2, 3, 4, 5, 6, 7, 8, 9}$  being absent;  $P_1$  4 mm. to 4.5 mm. long, with twenty joints, slender, and tapering evenly distally; first joint not so long as broad, second and third about as long as broad, the remainder about half again as long as broad; the joints are somewhat constricted centrally and have expanded and overlapping distal ends which are armed with fine spines, and a finely spinous dorsal surface; terminal comb very prominent, composed of six to eight large teeth, trapezoidal or blunt triangular, their bases in contact, somewhat higher than the transverse diameter of the joint which bears them, and recurved;  $P_a$  similar to  $P_1$ ;  $P_5$  (the next pinnule) 3 mm. long with twelve joints, the first two not so long as broad, the third about as long as its proximal diameter, the remainder somewhat longer than broad; all but the first have greatly expanded distal ends, armed with comparatively coarse spines; a very round and prominent genital gland is found on the second-fourth or second-fifth joints; following pinnules slowly increasing in length, the joints, except the two first, slowly becoming more and more elongated; distal pinnules about 4.5 mm. long, or about the length of the oral pinnules; the genital glands are found on three to six pinnules on either side of the arm and are always small and situated basally, like that on the first genital pinnule; large side plates are developed along the sides of the pinnule ambulacra of the third and following joints, becoming more perfect distally.

*Color* (in spirits).—Brownish white, the perisome yellow brown; probably yellow in life.

*Type*.—Cat. No. 25460, U.S.N.M., from Albatross Station No. 2670; between the Bahama Islands and Cape Fear, North Carolina; 280 fathoms.